ical charts, but which is all important in the mechanics of the earth's atmosphere when we come to consider its general circulation and the phenomena that depend on the diurnal rotation of the earth. The ordinary geographical maps of the Northern and Southern hemispheres are drawn as tho the observer stood over the North Pole and the South Pole, respectively, and lookt down upon the corresponding hemisphere; consequently a map of the Northern Hemisphere ordinarily represents longitude counted westward from Greenwich around the North Pole of the map as increasing in the anticyclonic or right-handed direction, while a map of the Southern Hemisphere represents the same longitudes, counted westward from Greenwich around the South Pole as increasing in the cyclonic or left-handed direction, as shown in the accompanying diagram, fig 2, Plate IV.

This method of treatment may do for descriptive geography and history and for navigators and geographers who consider only relative locations, but it is not appropriate for geophysical studies such as earthquakes. The immense inertia of the whole mass of atmosphere (revolving in one direction around the earth's axis, which we ought to call the left-handed, or positive, direction just as we do the similar direction of its annual revolution around the sun) is the most important item in meteorology, therefore we must recognize the necessity for a more rational treatment of the maps that are made for meteorological study. This is easily accomplished by drawing the polar map for the Northern Hemisphere on the plane *nn*, Plate II, as usual, viz, as seen by an observer looking down upon the earth from some point above the North Pole; then consider the earth as being transparent so that the observer, while retaining his position at or above the North Pole, looks thru the globe, as in fig. 3, Plate IV, and sees the Southern Hemisphere projected on the plane *ss* just as he had seen the Northern Hemisphere on *nn*. The two resulting maps, therefore, appear as in fig. 4, Plate IV; in both of them the longitudes circulate around the globe in the same direction as shown by arrows, L and L, while the diurnal rotation of the earth around its axis proceeds in the opposite direction as shown by the arrows R and R; the annual revolution about the sun also proceeds in this same opposite direction as shown by the arrows A and A.

By this arrangement of the maps of the Northern and Southern hemispheres, one can place the northern map above the southern with its center *n* superposed on *s*, and with a common axis of rotation so that the passage from the Northern to the Southern Hemisphere, at any point of the equator becomes continuous. In polar maps made on this system the cyclonic rotation within an area of low pressure, *x*, in the Northern Hemisphere is a positive or left-handed rotation on the map, and the so-called anticyclonic rotation around a similar area of low pressure, *y*, in the Southern Hemisphere becomes converted into a positive, a left-handed or cyclonic rotation, on the map. Thus the rules that have been formulated for ordinary usage on maps as ordinarily constructed, lose their antitheses, and the rotation about low areas is cyclonic or left-handed in both hemispheres, while the rotation about high areas is anticyclonic in both hemispheres. Any movement of the atmosphere will have a corresponding deflection toward the right on the maps of both the hemispheres alike.

If two raised maps be made according to this method, imitating the elevations and depressions of the earth's surface, one for the Northern and one for the Southern Hemisphere, respectively, and if one be placed above the other on a rotating shaft, as in fig. 5, Plate IV, and a little water be poured into the depressions on each chart, and the shaft be set in rotation, we have an approximate presentation of the action of the ocean on the globe. Experiments may thus be made with gases and liquids that shall approximately reproduce the motions of the atmosphere. By such laboratory experiments we may elucidate some of the difficulties attending the study of the general circulation of the atmosphere, since the formulas for passing from small models to the larger conditions of nature have already been given by W. von Helmholtz in his memoir on dynamic similarity.

21. Projections and models on concave surfaces.—The flat maps and models hitherto considered can serve only for a study of the motions of the lowest stratum of atmosphere, tending in general toward the equator. They must be supplemented by something better if we are to study by means of models the simultaneous motions of the upper strata which are moving in general poleward from the equator.

In the lowest stratum the general increase of temperature and humidity and the consequent diminution of density with diminution of latitude combine with the gravitational and centrifugal force to push the air toward the equator; when all this takes place on the ideal smooth sea-level surface or level surface of apparent gravity then gravity does not affect the motions except thru differences of density in masses of air of appreciable depth.

But in the upper strata the equatorial air either overflows poleward in a system of vertical circulations or overflows eastward and revolves horizontally while moving poleward in systems of circulation that soon make themselves felt at the earth's surface as areas of low pressure. In these upper strata a component of gravity is the force that overcomes the centrifugal force and other obstacles and produces the poleward flow down grade from which result the barometric gradients of our "lows" and "highs."

Hence we must devise a rotating model in which local gravitation at the laboratory shall give rise to descending poleward currents that shall simulate the overflow on the rotating globe. One way to accomplish this in a working model is to replace the flat maps by projections and models on concave curved surfaces, thus making shallow saucer-like models as in fig. 6, Plate IV. But the details of this construction belong to dynamics rather than to chartography.

THE JAMAICA HURRICANE OF OCTOBER 18-19, 1815.

By MAXWELL HALL, Esq., Government Meteorologist. Dated Chapelton, Jamaica, December 10, 1907.

This extraordinary storm, which lasted at Port Antonio for forty-eight hours, had some features resembling the hurricane of 1880. There were two centers, one of which moved slowly as it developed energy, while the other, fully developed, moved faster along its course toward the west-northwest, the usual direction. The motion of the former was abnormal; it was first toward the southwest, but when the center met the Blue Mountain Range south of Port Antonio, it stopt and even recoiled, and then advanced slowly again toward the southwest and Kingston.

Dr. W. Arnold has given a detailed account of the storm, as experienced at Port Antonio, in Vol. II of the Jamaica Physical Journal; he took great pains with the varying directions of the wind, and tabulated them at the end of his account so that there should be no mistake, and by means of a brief account of what occurred in Kingston, as given in the Royal Gazette, it is possible to make a short study of this storm. The small provisional maps attached to this article will be found useful.

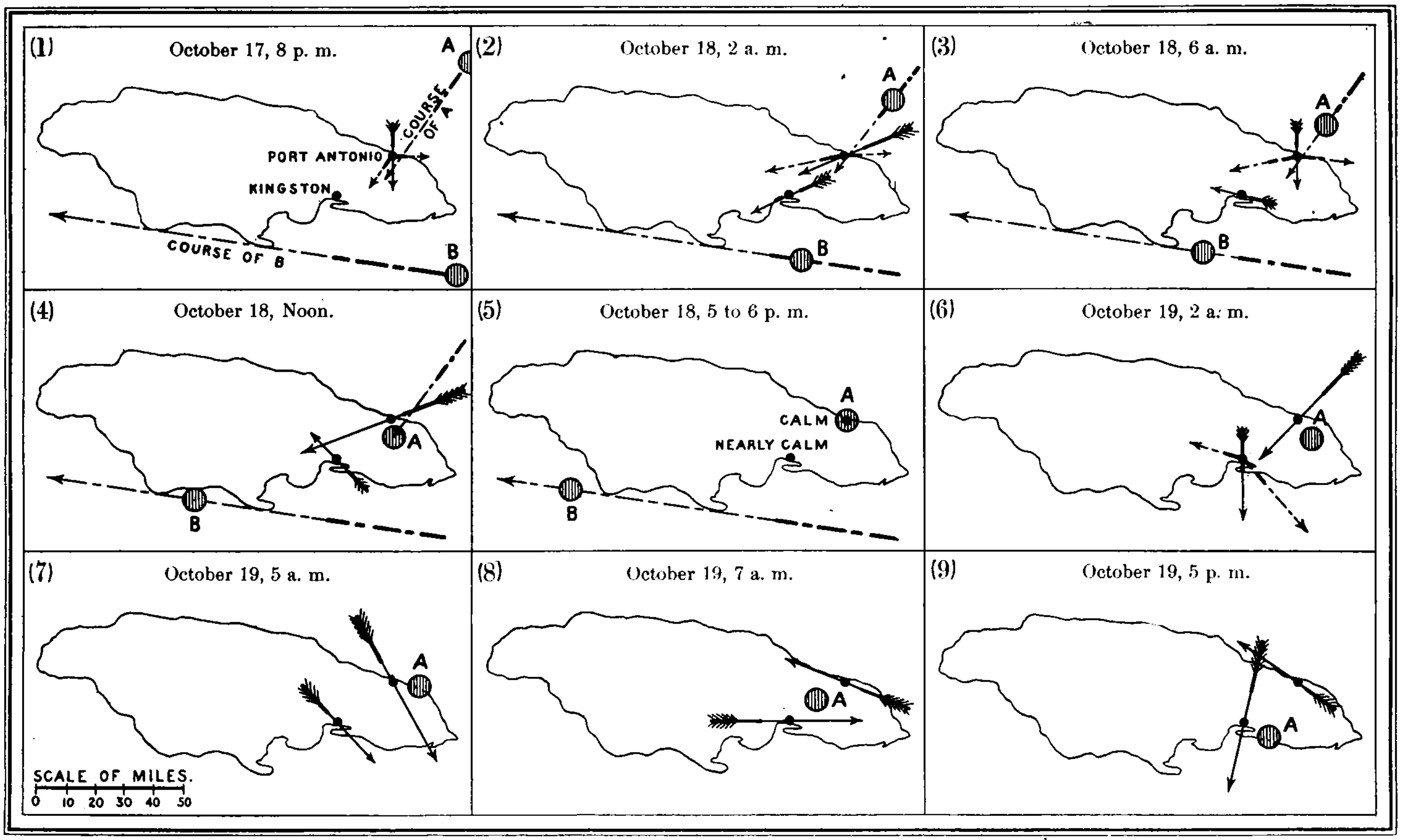
Extract from the Royal Gazette.[1]

KINGSTON, *Oct. 21st.*

SEVERE STORM.

On Tuesday, Oct. 17th, during the afternoon a heavy fall of rain set in, with a fair prospect of good October seasons; but about two o'clock on Wednesday morning it began to blow extremely hard from the eastward, from whence it changed to the SE; and on the following day it shifted to different quarter of the compass, from N to NW and W, and thence to N,

[1] From Saturday October 14, to Saturday October 21, 1815.



FIGS. 1-9.—The Jamaica hurricane of 1815. Supposed positions and paths of the centers at various hours. The direction and force of the wind at Port Antonio and Kingston are shown by arrows; the number of feathers represents the force by the Beaufort wind scale—4 indicating moderate breeze, 6 strong breeze, 8 fresh gale, 10 whole gale, 12 hurricane.

from whence it blew a perfect hurricane from about five o'clock in the after noon, and throughout the night, accompanied with heavy rain. Yesterday the weather moderated considerably, but during last night a strong breeze prevailed, which, however, lulled early this morning. Great damage has been done in all parts of the city, and almost all the wharves have suffered considerably * * *. At Up-Park Camp the new hospital at the west wing, 185 feet in length, occupied by the 18th Regiment of Foot, was completely thrown down about two o'clock on Thursday * * *. The old officers' quarters were likewise levelled to the ground, and the well-framed roof completely upset. At Stony Hill, we learn, the two northern barracks are completely uprooted, and the other buildings greatly injured * * *. The north wind occasioned a very heavy sea in Port Royal harbour; * * * in the town of Port Royal the gale was very severely felt: most of the old walls standing after the fire have been tumbled down, and the houses that remained after that calamity, as also others that have since been built, received much injury * * *. Not one of the mails from the country had arrived at the General Post Office when this paper went to press.

It may here be stated that this hurricane chiefly devastated the districts of St. David, Port Royal, and St. George—that is to say, the mountainous land between Port Antonio and Kingston. Most of the houses in these districts were rebuilt in 1816.

Dr. Arnold's account of the hurricane at Port Antonio.[2]

In the dreadful hurricane of 1815 the sky was previously clear, and a perfect calm pervaded the ocean; gentle westerly winds prevailed for a few days, which increased on the 17th of October and blew strong from that point for about three hours, when the wind veered to the north.[3] It was then evening. Little was thought what was to follow; in fact, we all considered it was nothing more than a north wind of common occurrence. I retired to rest in perfect security little anticipating the fury of the approaching storm. About midnight I was alarmed by the sudden bursting open of doors and jalousies; when they were closed and secured they did not prevent the intrusion of the rain; the wind whistled and forced the water literally through every crevice.

It blew all night from ENE;[4] towards daylight it changed again more to the N,[5] the sea rolling into the east harbour in waves of lofty grandeur.

About mid-day of the 18th the wind again changed to ENE,[6] increasing with spiteful fury; and with but trifling changes of a point or two more eastward, the hurricane maintained undiminished power over everything moveable—its force was irresistible. Trees out of number were torn up by the roots, provision and cane lands laid waste, houses unroofed, and blown to atoms.

Between five and six in the evening of this day there was an interval of comparative tranquility;[7] dark, dense, heavy masses of cloud were seen to be forced along from the NNE; but before half-past six sudden gusts again sprung up—the noise was frightful. I really do believe these gusts did more damage than when the gale blew steadily and with equal force. These squalls of wind and rain lasted till midnight. The thermometer the whole of the last twenty-four hours kept steadily at 75°; at noon of the 16th it was 82°.

After midnight I heard something like distant thunder—the tempestuous rage and roaring of the wind seemed to stifle all other sounds but its own; and had it not been for the occasional flashes of lightning, the subdued noise of the thunder would have passed unnoticed. The gale was blowing with increased violence from NE,[8] and before morning it was back again at NNW.[9] It is impossible to describe its fury at this moment—the whole firmament was dark as chaos. Thus we remained for the space of three hours, when a faint glimmer of light was perceived towards the north; it was cheering to see this beam of brightness. It was a fearful night.

Early on the morning of the 19th the wind was ESE;[10] at 7 a. m. the hurricane threatened universal destruction; the undulation of an earth-

[2] Jamaica Physical Journal, Vol. II.

[3] Fig. 1.—The wind had previously been west, due to the developing cyclone *A;* the cyclone *B*, advancing along its path, now made its presence felt, and the resulting wind was north.—*M. H.*

[4] Fig. 2.—The wind was chiefly influenced by the more powerful cyclone *B.—M. H.*

[5] Fig. 3.—The near approach of *A* produced this change; but there was little wind at both places.—*M. H.*

[6] Fig. 4.—The wind was now entirely influenced by *A*, which had advanced on its course and developed.—*M. H.*

[7] Fig. 5.—The onward course of *A* was arrested; and the center moving north a little, Port Antonio was in the central calm area; Kingston was between the two centers.—*M. H.*

[8] Fig. 6.—The center had moved south again a little.—*M. H.*

[9] Fig. 7.—Another very small oscillating movement northeast.—*M.H.*

[10] Fig. 8.—The center began to move again on its former southwestward course.—*M. H.*

quake was felt; the rain poured down in torrents; few who have read, few who have heard related what a hurricane is, can form but a very imperfect idea of the horrifying contention of the elements.

About noon the wind suddenly chopped round to ENE; the gale at this time was more moderate: the rain had subsided. Before 4 p. m. the gale was from the SE in dreadful gusts;[11] at 7 p. m. the rain poured down in torrents, the lightning was vivid, incessant, and terrific; a more dismal night could not be pictured in any mind; the sudden blasts of wind and rain betokened a continuation of this most frightful storm; luckily, however, before the dawn of day it moderated; at daylight on the 20th the wind was SE fresh and strong, and continued so till noon when it moderated.

Between figs. 8 and 9 another might have been inserted showing an oscillation of the center to the south of Port Antonio about noon, but it was not considered necessary.

It is greatly to be hoped that the publication of these notes may bring to light further information. For instance, we want to know how Annotto Bay and Port Maria, 30 and 40 miles west of Port Antonio, respectively, fared under a gale from the north for at least twenty-four hours. The last hurricane, in 1903, was moving rapidly, at the rate of 20 miles an hour, yet during the short time the wind was north at these places it drove the sea ashore in a most threatening manner.

Pending further inquiry, it may be remarked that without barometers, or without barometers in proper order, it would seem impossible for people in those days to arrive at any conclusion as to the nature of a "hurricane" by noting, however carefully, the varying directions of the wind.

CLIMATOLOGY OF JACKSONVILLE, FLA., AND VICINITY.

By T. FREDERICK DAVIS, Observer, U. S. Weather Bureau. Dated Jacksonville, Fla., January 31, 1908.

Situation and general remarks.—To Jacksonville belongs the distinction of being the farthest west of any city on the Atlantic seaboard. Its longitude and latitude are 81° 39′ W. and 30° 20′ N.

The city is situated on slightly rolling ground on the north bank of the St. Johns River, and has a river frontage of $2\frac{1}{2}$ miles. The back country is generally flat. In a direct line the city is 16 miles from the ocean.

Under normal conditions the climate is equable, altho there are often clear, cold, bracing days in winter and high midday temperatures in summer. Early spring and late autumn are the most pleasant seasons of the year, as they are characterized by pleasant temperatures and a greater percentage of clear skies.

The changes in weather conditions in this vicinity are due chiefly to the shifting of the areas of high and low barometric pressure over the country, the amount of the change depending upon the proximity and strength of the influencing factor. In winter a spell of rainy weather is nearly always followed by a shift of wind to westerly, thru the south quadrant, and by colder weather within twelve to twenty-four hours. The storms that give these winter rains are principally of the southwestern type, originating in the west Gulf of Mexico, or in Mexico. Their normal course is northeasterly, and their influence upon local weather conditions begins when they are not more than 400 miles distant, or, in other words, about as far away as the State of Mississippi. The wind here is then northeasterly, and, as the storm progresses northeastward, it veers gradually to southeast and south, when with a rapid shift it goes to westerly, and the cold air of the advancing high-pressure area is ushered in. These conditions typify our cold waves.

In summer stagnant pressure conditions prevail. The presence in this vicinity of the West Indian storms, known as hurricanes, always produces a marked departure from normal weather conditions. These storms, fortunately, are not of frequent occurrence. So far as they affect local weather conditions, they may be divided into two classes: (1) those that recurve into the Atlantic Ocean over the lower peninsula and (2) those that enter the east Gulf and recurve about latitude 29°. Storms of the former class seldom affect conditions here, except occasionally by causing heavy rains; but with those of the second class there are experienced all the phases connected with storms of the tropical type.

Meteorological records.—The data in the tables for the period June, 1829, to August, 1833, are from the records of Judge F. Bethune, made at his plantation some 5 miles south of Jacksonville. Terdaily readings were made—about the hours of sunrise, 1 p. m., and 8 p. m., local mean time—of a thermometer that was exposed on his front porch, but unfortunately no more is known of this exposure.

The record from 1838 to January, 1872, was made by Dr. A. S. Baldwin, a man of scientific turn of mind, with a leaning toward meteorology. The lapses in this record were due to the Indian and the Civil wars. The best thermometers then obtainable were used. Doctor Baldwin's observations were made terdaily—at 7 a. m., 2 p. m., and 9 p. m., local mean time. The thermometer was exposed on the front door facing of his porch, and the instrument was well sheltered from the direct and reflected rays of the sun. Until December, 1861, the elevation was 13 feet 11 inches above sea level; beginning February, 1866, it was 20 feet, probably due to his removal to another residence two blocks farther north. In both locations the instrument was about 7 feet above the ground.

On September 11, 1871, the United States Signal Service (whose meteorological work was transferred to the United States Weather Bureau on July 1, 1891) established a station here, in the Masonic Hall Building, occupied until September 19, 1871, during which time partial observations, only, were taken. September 20, 1871, the station was removed to the Freedman's Bank Building, Pine and Forsyth streets. This office was occupied until July 21, 1880. Here the thermometers were exposed in the regulation window shelter, 20 feet above the ground. The rain gage was on the top of the building, 64 feet above the ground and 69 feet above sea level. The third office was in the Astor Building, Bay and Hogan streets, and was occupied from July 22, 1880, to July 31, 1902. The elevations of the instruments above ground were: Thermometers, 37 feet, exposed in a window shelter until October 1, 1886, when they were placed in a roof shelter 69 feet above ground; rain gage, 57 feet; anemometer, 84 feet. To reduce to sea level add $7\frac{1}{2}$ feet. On August 1, 1902, the station was removed to its present location, Dyal-Upchurch Building, Bay and Main streets. Here the elevations of the instruments above the ground are: Anemometer, 129 feet; thermometers, 101 feet; rain gage, 88 feet—the ground being about 7 feet above sea level.

In Table 3 the annual minimum temperatures for the years not covered by Judge Bethune's and Doctor Baldwin's records were compiled by Maj. George R. Fairbanks, historian, who collected these data from various reliable sources.

Time used.—The entries of time until January 1, 1885, were local mean time; after that date, standard ninetieth meridian time, which is thirty-three minutes slower than local mean time, is used.

Discussion of mean temperatures.—The mean temperatures, Table 1, prior to January, 1874, were obtained by the formula $(7+2+9)\div3$, but this gives a mean somewhat higher than the true mean. The formula $(7+2+9+9)\div4$ gives a result very near the true mean temperature. The "Correction" line in the middle of Table 1 represents the ten-year mean of actual differences for each month between these two formulas, and these values should be applied to the Bethune and Baldwin means, and to the means of the first section, as a reduction to the true mean temperature. In finding these correc-

[11] Fig. 9—The wind remained southeast all night, showing that the center continued to move southwestward.—*M. H.*